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(54) An arrangement for the storing of oil at a semi-submersible platform

(57) A buffer storage tank (21) at a semi-submersible production platform having at least two underwater floaters (12, 13) is mountable between the latter and communicates with the deck structure (10) of the platform by means of a shaft (23). The shaft encloses, just above the tank a pump room (24), and above the latter a separating chamber (25) which communicates with the surrounding sea below, as well as above the operational water line (OWL).

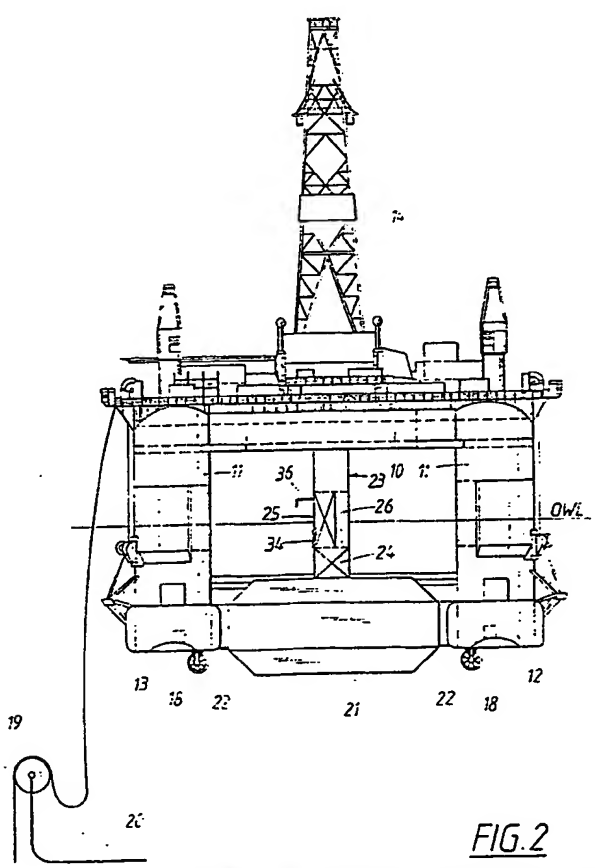

FIG.2

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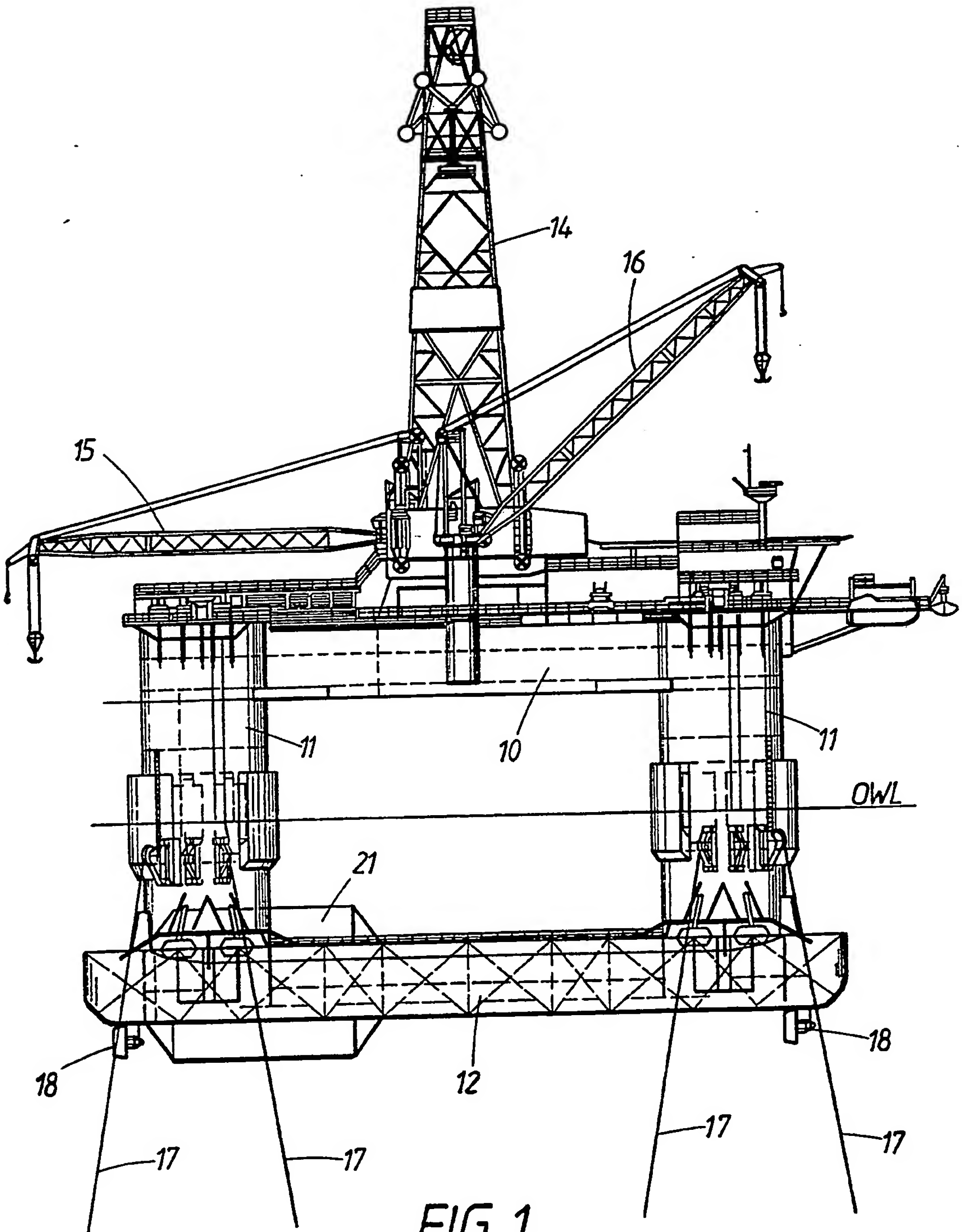


FIG. 1

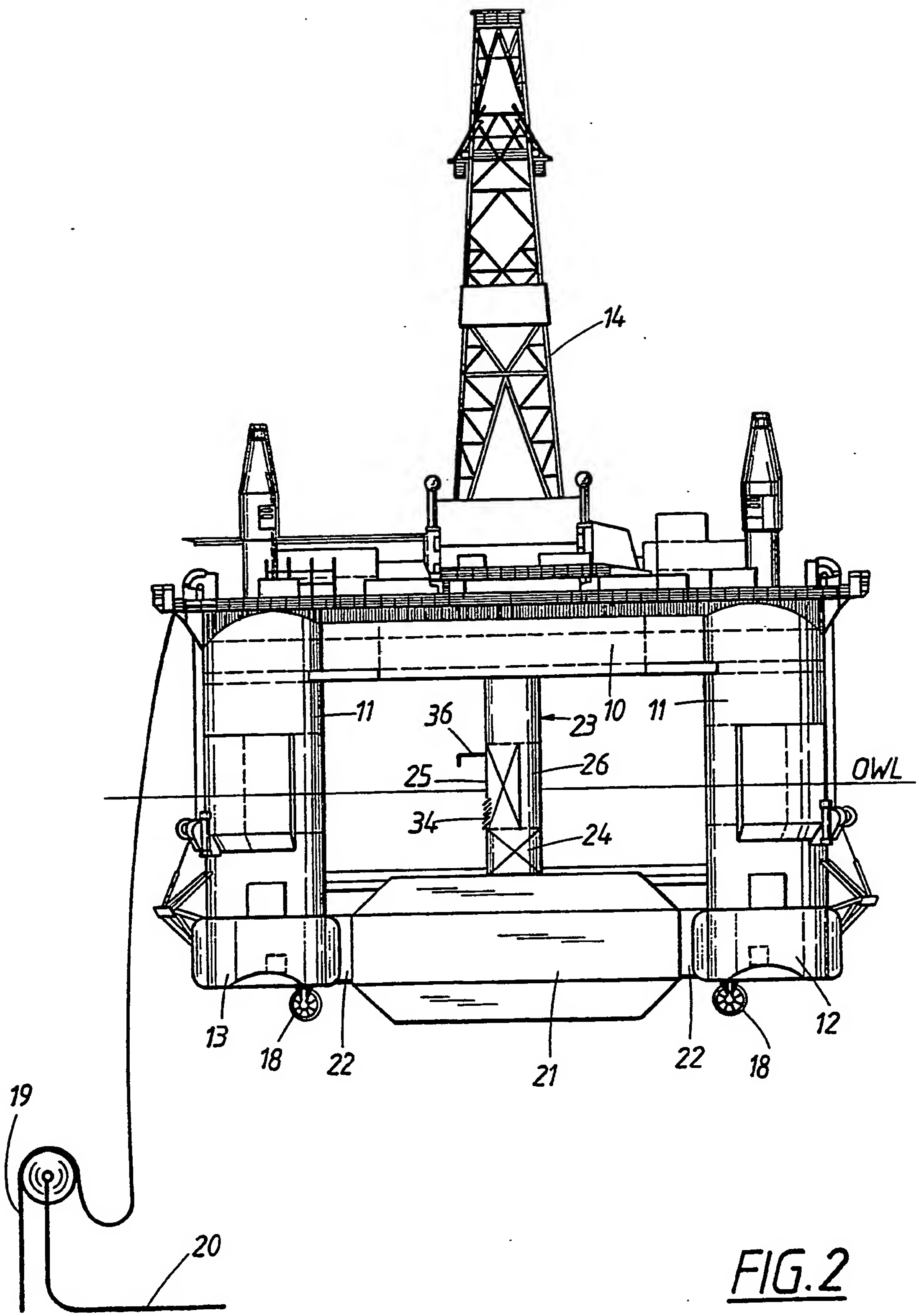


FIG.2

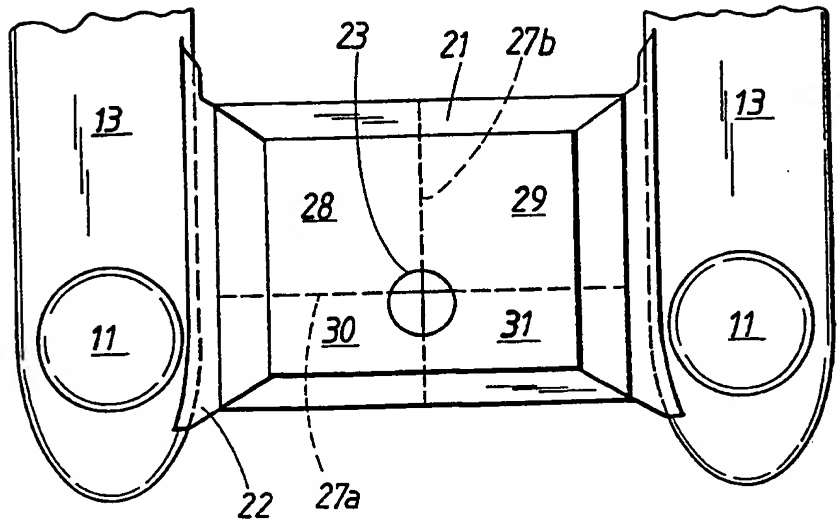


FIG.3

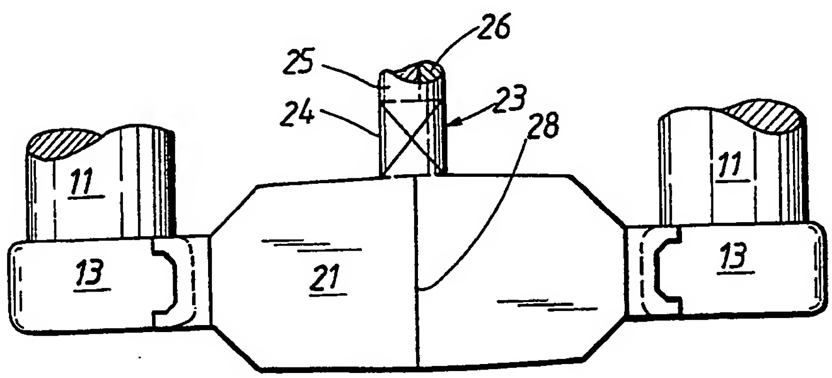


FIG.4

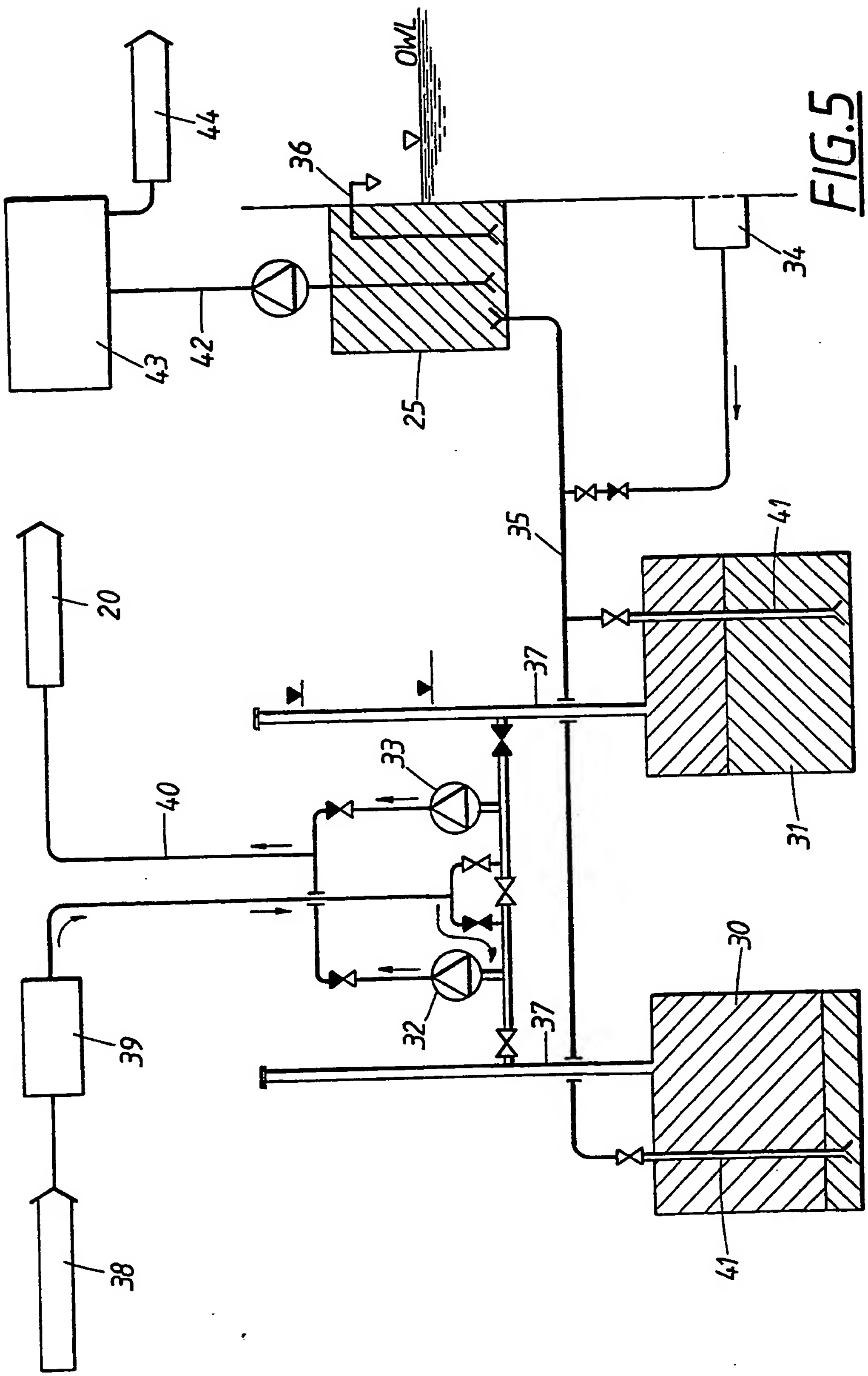


FIG.5

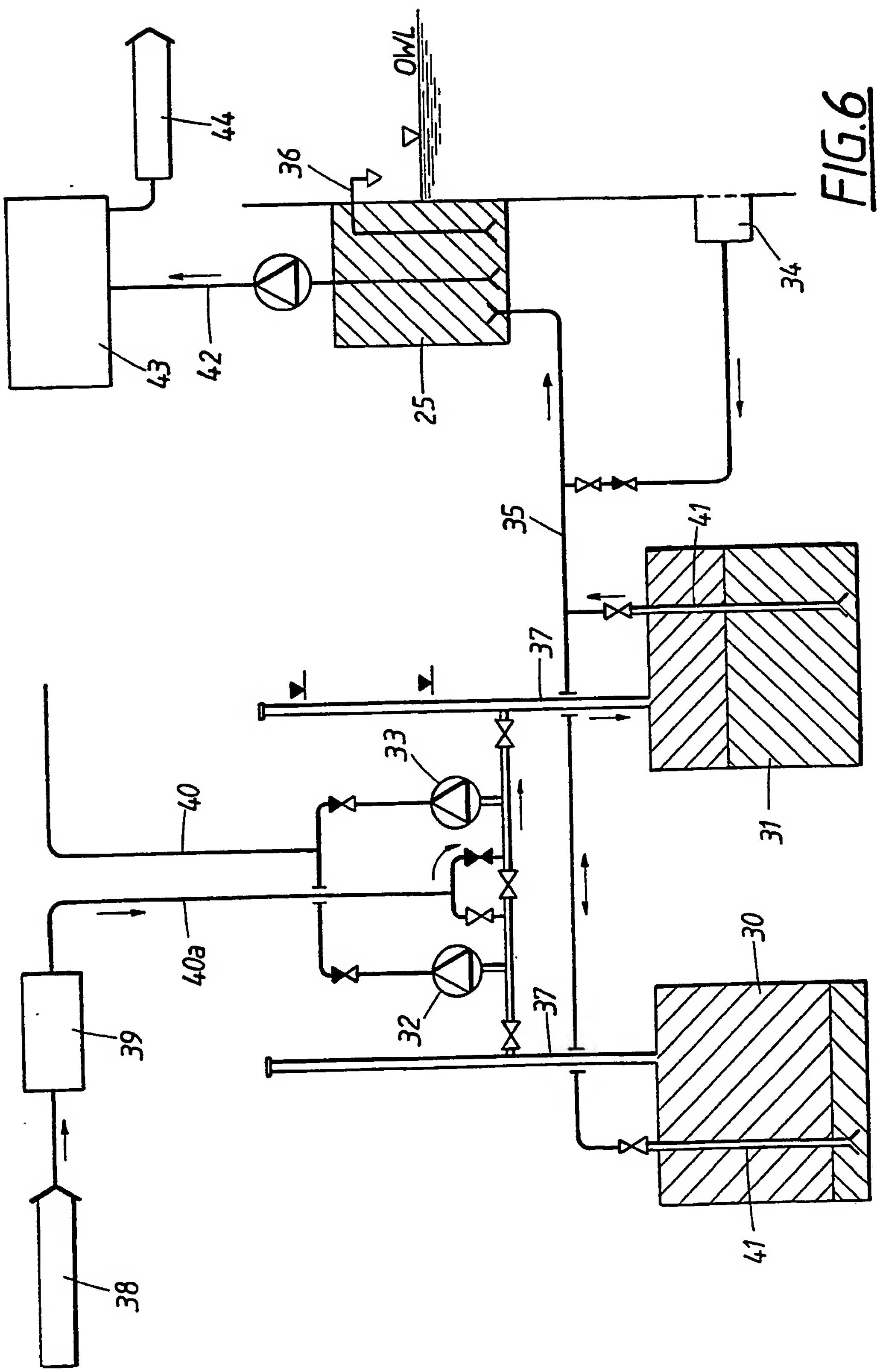
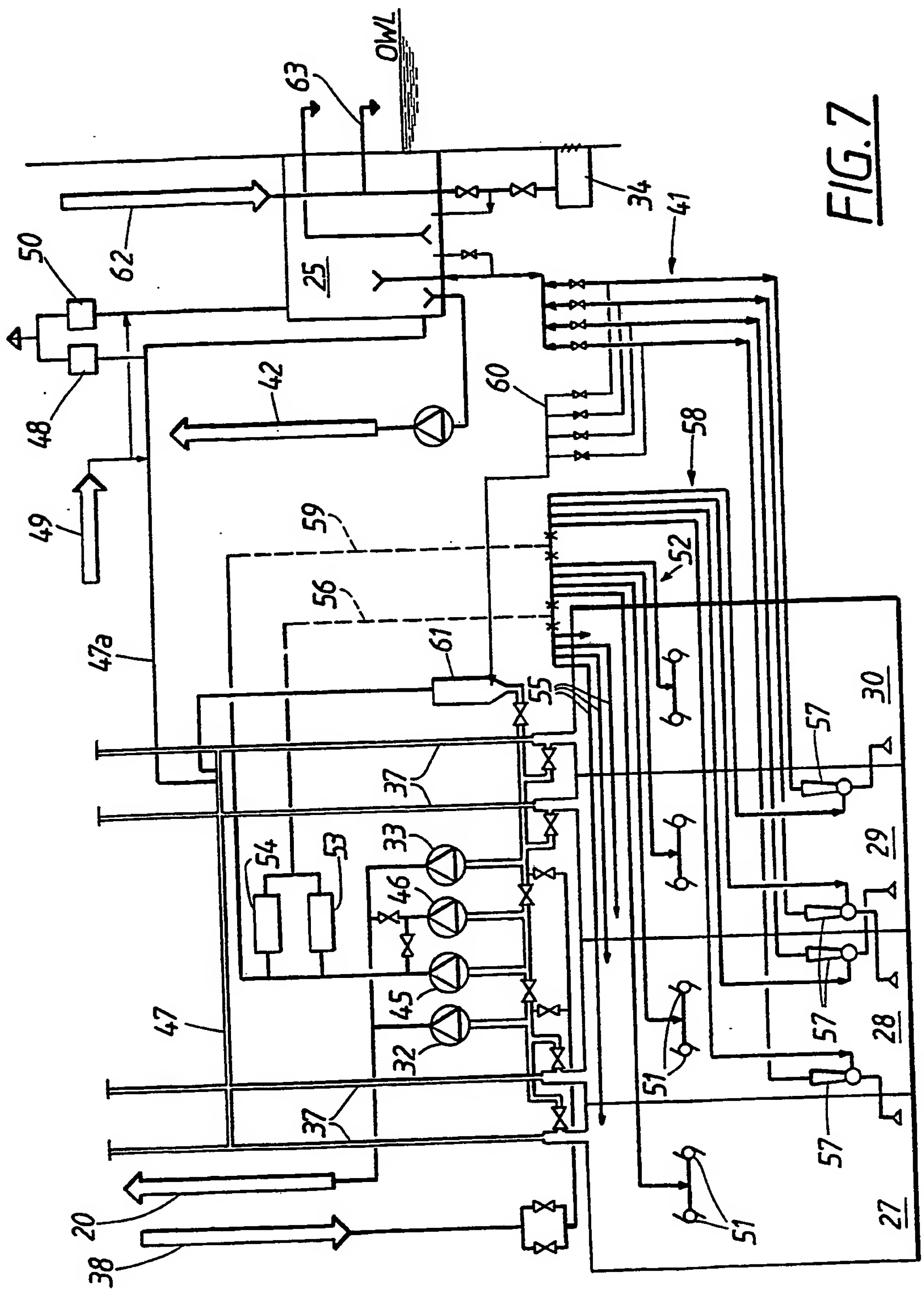


FIG.6


OWL
63
62
50
48
49
42
25
34
41
60
58
59
56
52
61
55
47a
37
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27

FIG.7

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AN ARRANGEMENT FOR THE STORING OF OIL AT A SEMI-SUBMERSIBLE PLATFORM

At an offshore production platform it is often difficult to provide a sufficient storage capacity. Often a shuttle tanker is moved adjacent to the platform for taking care of the running production, but it is necessary to have some receiver for the oil produced when the tanker is returning to a harbour for unloading.

The storing of oil upon a water bed is a known concept.

An extra storage space ought to be arranged in such a manner that the weight of the stored oil will influence the platform as little as possible. This may be achieved if the storage tank is located below the water level.

The storage tank should be designed so that the chance of air or gas pockets being formed is small, and the pumps ought to be located so they are easily accessible from the deck structure of the platform and with short piping between pumps and tanks.

The volume of the water bed in the tank will vary depending upon loading and unloading conditions, and the water withdrawn must be cleaned before it is returned to the sea.

The invention thus relates to an arrangement for the storing of oil at a semi-submersible platform of the type comprising a deck structure, which by means of columns is carried by at least two underwater floaters and is characterized by a tank mounted between two floaters and provided with at least one shaft communicating with the deck structure and just above the tank enclosing a pump room and in a space thereabove at least one separating

chamber, communicating with the surrounding sea, below as well as above the operation water line.

By locating the pumps on top of the storage tank, the pump room will be easily accessible from the deck structure of the platform. As the pumps will draw from the standing pipes it will be impossible to lower the level in the tank to below the top plating. No dangerous gas accumulation will occur during normal cargo handling, which is important in view of safety conditions.

The short piping between pumps and the tank reduces the risk for clogging.

The pressure level in the storage tank will be determined by the location of the separating chamber, where the effluent pipe and the sea chest in relation to the level of the surrounding sea will define the margins. There is thus no risk of overpressure occurring in the tanks.

A storage tank of the type intended here may, as a practically complete unit, be welded to an existing platform, with a minimum of encroachment upon the structure thereof.

As the storing occurs below water level, and the tank is always filled with either oil or water, only a small weight addition to the platform will occur, even with a large storing capacity.

The tank is advantageously subdivided into a number of rooms by means of longitudinal and transverse bulkheads, and the shaft is so located that it can communicate directly with a number of rooms.

Standing pipes mounted at the top plating of the tank, or the tank rooms, respectively, preferably extend to above

the operationed water line (OWL), the suction sides of the pumps being connected to the standing pipes.

As the shaft is located above a number of tank rooms it is possible to lower diverse equipment (preferably by way of the standing pipes) into the rooms, viz. for level indication, definition of border layers, test sampling, measuring of wax content, sediments and so forth. The standing pipes extend above normal oil level, and serve as gas effluents by way of a pressure/vacuum relief valve, and include a valve for the supply of inert gas as well as air from fans when the tank rooms are to be ventilated.

The separating chamber is preferably connected to the individual tank rooms by way of conduits opening close to the bottom of the rooms, as well as to at least one conduit for transferring the withdrawn water to a water purification plant.

Certain oils have a high content of wax, which crystallizes at low temperature and sinks to the bottom of the oil body. In order to abate such activity the temperature of the oil will have to be raised, for instance by means of re-circulations pumping by way of a preheater.

A further possibility of maintaining an elevated temperature is to heat the water bed, which can be achieved by conducting cooling water from engines and process equipment out by way of the separating chamber. This will then always be filled with warm water, and when oil is withdrawn this warm water will compensate the withdrawal.

The piping between the tank rooms and the separating chamber preferably includes ejectors close to the bottom

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The semi-submersible platform shown in Figs. 1 and 2 is of conventional type, and includes a deck structure 10, which by means of four columns 11 is carried by two underwater floaters 12 and 13. The deck structure is provided with a derrick for boring, and cranes 15 and 16 for the handling of goods.

Other types of platforms may have a larger number of columns and floaters, but that will not affect the invention.

A platform is conventionally moored at the oil field by means of wires or chains 17 extending to anchors at the bottom of the sea, and is often maintained in a desired position by means of thrusters 18, so called dynamic positioning.

The platform is connected to wells in the bottom of the sea by means of a number of risers 19, and the deck structure 10 carries process equipment for separating the received mixture of oil, gas and water.

The oil will leave the platform by way of an "export riser" 20, which is connected to a buoy or the like, to which a tanker can be moored for receiving a cargo.

For occasional, intermediate storing of produced oil a tank 21 is provided, which is fitted between and attached to the rear portions of the floaters 12 and 13. As is evident from Fig. 1 the tank does not extend as far in the forward direction as to prevent work below the derrick 14.

The tank 21 is connected to the floaters by means of cofferdam structures 22. When the platform is raised to transit position the deck of the floaters and adjacent positions thereof will project above the water level.

This makes it possible to bail out the cofferdams to make them accessible for inspection of enclosed surfaces of the floaters and the tank.

Figs. 1 and 2 show the platform in operational position with the tank 21 well below the water surface. As will be evident from the following description related to the following figures, the oil is stored in a water bed, the level of which will change as oil is applied or withdrawn.

The tank 21 communicates with the deck structure 10 by way of a shaft 23. A pump room 24 is located in this shaft just above the tank. Above the pump room there is a separating chamber 25 which extends above, as well as below the operational water line, OWL. The separating chamber does not fully cover the cross section of the shaft, but leaves a passage 26 down to the pump room.

Figs. 3 and 4 show the tank 21 with its connections to the floaters 12 and 13, in a plan view and as seen from abaft, respectively.

The tank 21 is subdivided into four rooms 28, 29, 30, 31 by means of a transverse bulkhead 27a and a longitudinal bulkhead 27b. The shaft 23 stands above the bulkheads 27a and 27b, so it will communicate directly with each room.

Figs. 5 and 6 schematically show arrangements for withdrawing and supplying oil from or to the rooms in the tank 21. A number of details have been deleted in order to simplify the description of the pertinent operations.

Only two tank rooms, for instance 30 and 31, are shown. The pump room is not shown but is, as mentioned above,

located just above the tanks, and houses i.a. cargo pumps 32 and 33.

The separating chamber 25 is provided with an overflow conduit 36. A sea chest is denoted by 34, and is connected to a main conduit 35 to and from the separating chamber 25.

A standing pipe 37 is connected to the top plating of each tank room 30, 31, and the suction sides of the pump are connected to the standing pipes. The pipes 37 extend to a distance above the water line, and are in the drawing shown as closed at their upper ends. As will appear in the following description, the standing pipes are connected to a pressure/vacuum relief valve, and to a source for supplying inert gas.

As is mentioned above, the separating chamber is located above the pump room, but in Figs. 5 and 6 the chamber is shown to the side of the pumps, in order better to use the space of the drawing sheet. The level in the separating chamber 25, which determines the pressure in the tank rooms 30, 31, will however ensure satisfactory flow to the pumps.

The process plant in the platform schematically denoted by 38, and reference 39 denotes measuring equipment for controlling the flow.

A pressure conduit 40 from the pumps 32 and 33 is connected to "export riser" 20.

The main conduit 35 from the separating chamber 25 is extended to the bottoms of tank rooms 30, 31 by vertical pipes 41. As will be explained in connection with Fig. 7, these pipes may be designed in various ways, and possibly be provided with ejectors.

A riser conduit 42 extends from separating chamber 25 to a plant 43 for purifying the water withdrawn from tanks 30, 31. The cleaned water is dumped overboard by way of a conduit 44.

In Fig. 5 new produced oil is supposed to flow from plant 38 by way of pump 32 to "export riser" 20, while pump 33 draws oil from tank room 31. The tank room 30 mainly contains oil. Sea water automatically flows from the sea chest 34, by way of the main conduit 35 and the vertical pipe 41 down to the bottom of tank 31. During this operation, no water will pass through conduit 42. When tank has been emptied of oil, pump 33 may handle the new produced oil, while pump 32 draws from tank room 30, in the same manner as described above.

Fig. 6 shows the situation in an intermediate period, when no tanker is available for receiving cargo.

The new produced oil passes by way of a drop pipe 40a past the pumps 32, 33 to either standing pipe 37 - here the one connected to tank room 31. This room will then, in due time, be filled with oil. The water which is displaced by the oil passes up through the vertical pipe 41 and is, by way of the main conduit 35 conveyed to the separating chamber 25, from which it is pumped to the purification plant 43.

Fig. 7 shows a more complete picture of the plant than Figs. 5 and 6. All four tank rooms 28-31 are shown. Beside the cargo handling pumps 32 and 33 there is a circulation pump 45, which has a larger capacity than any of the cargo pumps, but provides a lower pressure, as well as tank washing pump 46. All four standing pipes 37 are interconnected by a conduit 47, located at a higher level than normally occurring oil level. This conduit

is, in turn, by way of a conduit 47a, at a still higher level, connected with the separating chamber 25. The conduit 47a is also connected to a pressure/vacuum relief valve 48.

The intention is to prevent bursting of any tank room as a result of valves being erroneously closed in any of the pipes 41, or by those being clogged, for instance by wax sediments.

If that should occur oil will rise, on the one hand, so that overflow to an adjacent standing pipe and tank room occurs. Then oil will, on the other hand, flow to the separating chamber 25, which, in turn, is protected by the overflow pipe 36. As this extends from the bottom of the chamber, water will first flow overboard. The overflow pipe is advantageously provided with a flow sensor, connected to an alarm device.

The standing pipes 37 and the conduits 47, 47a and pipe 36 do not include any shut-off devices. The highest static pressure to which the tank system may be subjected is determined by the highest level in connection conduit 47a. The tanks may therefore be dimensioned for a lower pressure than the usually determining pressure, i.e. overpumping by way of valve 48, which is located at a considerably higher level.

A source 49 for supplying inert gas is connected to conduit 47. A further pressure/vacuum relief valve 50 is connected to the separating chamber 25.

In each tank room 28-31 there are two tank washing devices 51, with associated conduits 52. The circulation ump 45, may draw oil from either tank room 28-31, and supply it to heaters 53, 54 from which the oil, by way of conduits 55 will be returned to a selected tank room.

The temperature of the oil may in this manner be maintained at a level suitable for pumping, and with a reduced risk of wax settling out. Alternatively the heated oil may be supplied to the tank washing devices 51. Those may alternatively be supplied with water by way of conduits not shown in the drawing.

The vertical conduits 41 connected to the separating chamber 25 are here each provided with an ejector pump 57, which make possible a complete emptying of the tank rooms. Those are then preferably filled with oil. The ejectors 57 are driven by oil, supplied by way of conduits 58, which, in turn, are connected to a pressure conduit 59 from the tank washing pump 46. Conduit 59 may alternatively be connected to conduits 52, so the tank washing devices are supplied with unheated oil.

The oil flowing out through conduits 41 is, by way of branch pipes 60, conveyed to a separator 61, where possible gas is separated out, and returned to the tank or is blown off by way of the pressure/vacuum relief valve 48.

When the tank rooms are to be completely drained of water the conduits 41, in the manner described above, are connected directly to the separating chamber 25. The ejector pumps will then be driven by water.

The conduits 41, 52, 58 and 55 are in this figure shown in the plane of the drawing, and are drawn beside each other. In the practical embodiment they will pass the roof of the tank within the shaft 23.

The cooling water from engines and process equipment, denoted by 62, is brought to pass through the separating chamber 25, so this is always filled with warm water. When there is no need for heated water to tank 21, the

cooling water will be dumped by way of effluent 63, otherwise it will, in the manner described above, be conveyed to the tank room occasionally being emptied of oil by way of either conduit 41.

As an alternative to the supply of cooling water, sea water from the sea chest 34 may be supplied by free flow to the separating chamber 25.

The plant above described and shown in the drawings may be varied in many ways within the scope of the appended claims. The size of the tank will be determined by the expected demand for storage space, and the attachment of the tank to the two floaters will increase the global strength of the platform. For a man skilled in this art it is evident that surveying and safety devices will be available at a number of apparatuses included in the plant, but that there is no need to show those in the drawing.

CLAIMS

1. An arrangement for the storing of oil at a semi-submersible platform of the type comprising a deck structure, which by means of columns is carried by at least two underwater floaters characterized by a tank mounted between two floaters and provided with at least one shaft communicating with the deck structure, and just above the tank enclosing a pump room and in a space thereabove at least one separating chamber, communicating with the surrounding sea, below as well as above the operation water line.

2. An arrangement as claimed in claim 1, characterized in that the tank by means of longitudinal and transverse bulkheads is subdivided into a number of rooms, and in that the shaft is so located that it directly communicates with several rooms.

3. An arrangement as claimed in either claim 1 or claim 2, characterized in standing pipes extending from the top plating of the tank or the rooms, respectively to above the operating water line (OWL), and to which the suction side of the pump, or pumps are connected.

4. An arrangement as claimed in claim 3, characterized in that the standing pipes are interconnected by a conduit located at a level higher than the highest, normally occurring oil level, and connected to the separating chamber.

5. An arrangement as claimed in claim 4, characterized in that the conduit is connected to a pressure/vacuum relief valve, as well as to a source supplying inert gas.

6. An arrangement as claimed in any one of the preceding claims, characterized in the separating chamber being connectable to individual tank rooms by conduits extending close to the bottom of the associated room, as well as to at least one conduit for the transfer or withdrawn water to a water treatment plant.

7. An arrangement as claimed in claim 6, characterized in that the separating chamber is further connected to conduits transferring cooling water from engines and process equipment within the deck structure.

8. An arrangement as claimed in claim 6, characterized in that the conduits include ejectors for complete emptying of the tank rooms.

9. An arrangement as claimed in any one of the preceding claims, characterized in conduits connected to the oil handling pumps and provided with heaters for circulating the oil stored in the tank rooms.

10. An arrangement as claimed in claim 9, characterized in the tank rooms being provided with tank washing equipment connected to conduits supplying heated oil.

11. An arrangement as claimed in any one of the preceding claims, characterized in that the tank is connected to the floaters by way of drainable cofferdams.

12. An arrangement for the storing of oil at a semi-submersible platform substantially as hereinbefore described, with reference to, and as shown in the accompanying drawings.

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